

On *Limnocodium victoria*\*, a new Hydroid Medusa of Fresh Water.

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[Received June 14, 1880; Read June 17, 1880.]

I AM indebted to Mr. Sowerby, of the Botanical Society's Gardens in Regent's Park, for having called my attention to the fact that certain medusoid organisms had shown themselves in the gardens, where they had become developed in great abundance in one of the warm tanks devoted to the cultivation of the *Victoria regia*.

So startling a fact as the occurrence of a medusa in fresh water demanded immediate examination, and, through the kindness of Mr. Sowerby, I was enabled to make a careful study of the remarkable phenomenon to which my notice was drawn by him.

A visit to the tank made apparent the correctness of Mr. Sowerby's observation, for the water, which had a temperature of 86° Fahr., was literally swarming with little medusæ, which varied in size from about a line in transverse diameter to nearly half an inch. They were most energetic in their movements, swimming with the characteristic systole and diastole of their umbrella, and apparently in the very conditions which contributed most completely to their well-being.

A closer examination showed them to be true hydroid medusæ, and revealed some very interesting structural features. The umbrella varies in form with the state of contraction, passing from a somewhat conical shape with depressed summit, through figures more or less hemispherical, to that of a shallow cup. The radiating canals are four in number and open into a wide marginal canal; and the manubrium is large and, when extended, projects beyond the margin of the umbrella; its lips are destitute of tentacles, but everted and plicated (fig. 2).

The marginal tentacles are filiform; they are numerous, nearly 200 in old individuals, and are of unequal size. The longest and thickest correspond to the points where the four radiating canals open into the marginal canal. In each interval between these, and at equal distance from one another, occur seven somewhat smaller tentacles, and between these again other still smaller ones. The velum is of moderate width, and the extreme margin of the umbrella is wavy and thickened and loaded with brownish-yellow pigment-cells.

\* Instead of "*victoria*," Prof. Lankester employs the specific name *Sowerbii*, after Mr. Sowerby, the discoverer of the medusa—a modification of the nomenclature used above, which I am quite willing to adopt.

The marginal bodies are about 128 in number, and consist of a highly refringent spherical corpuscle surrounded by a delicate transparent capsule. This capsule is very remarkable, for, instead of presenting the usual spherical form, it is of an elongated piriform shape. In its larger end is lodged the spherical refringent body, and it thence becomes attenuated, forming a long, tubular, tail-like extension, which is continued into the velum, in which it runs transversely towards the free margin of this membrane, and there, after becoming more or less convoluted, terminates in a blind extremity (fig. 3).

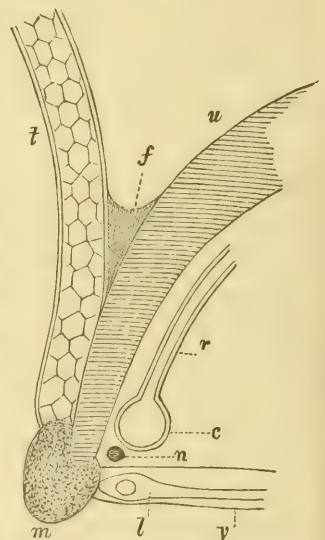
The reproductive sacs are borne on the radiating canals at a short distance beyond the exit of these from the manubrium. They are of a piriform shape, and spring by their narrow ends from the canal, whence they hang down free into the cavity of the umbrella. Their colour is a brownish yellow, derived from the pigment-cells developed in their endoderm.

The manubrium is of a similar brownish-yellow colour, due also to the pigment-cells of its endoderm.

The following notes have been made since the above was received:—

The attachment of the tentacles is peculiar. Instead of being free continuations of the umbrella-margin, they are given off from the outer surface of the umbrella, at points a little above the margin and at three or four different levels. From these points, however, each may be traced centrifugally in the form of a ridge as far as the thickened umbrella-margin (fig. 1). This ridge consists of the proximal portion of the tentacle, which is here adnate to the outer surface of the umbrella. It holds exactly the position of the "Mantelspangen," or *peronia*, so well developed in the whole of the Narcomedusæ of Hæckel and in some genera of his Trachomedusæ\*. Its structure, however, differs from that of the true *peronia*, which are rib-like lines of thread-cells marking

Fig. 1.



Diagrammatic meridional section of Medusa through a radial canal.

*u*, umbrella; *m*, thickened and pigmented margin; *v*, velum; *l*, lithocyst; *r*, radial canal; *c*, circular canal; *n*, nerve-ring; *t*, tentacles; *f*, frenalium.

\* Relations of *Limnocoedium* to the Trachomedusæ are maintained by Prof. Lankester, who refers the medusa to the Trachomedusal family *Petasidæ*. See 'Nature' for June 17, 1880, and his paper of the same date read at the Royal Society.

the path travelled over by the tentacle as its insertion moved in the course of metamorphosis from the margin of the umbrella to a point at some distance above it; while in *Limnocodium* the ridges are direct continuations of the tentacles, whose structure they retain. They suggest a comparison with the root-like continuation of the tentacles, which are plunged into the substance of the umbrella in the *Narcomedusæ* and in certain *Trachomedusæ*. Just before reaching the margin they become narrower, and are ultimately inserted on the summits of the sinuses into which the thickened margin is thrown. The intrant angle between the free portion of the tentacle and the umbrella is rounded off by a frenum-like extension (fig. 1, *f*) of the outer epithelium of the umbrella.

I could find no indication of a cavity in the tentacles, a feature in which they resemble the solid tentacles of the *Narcomedusæ* and *Trachomedusæ*. Instead, however, of possessing the peculiar axis composed of large cylindrical or disk-shaped cells laid one on the other like coins in a rouleau, which is so prevailing a characteristic of the tentacles in these orders, the axis is here formed of an irregular tissue of polygonal cells. This pith-like axis is surrounded by a membranous tube (which probably consists of the "Stützlamente" with muscular fibres), and this, again, by a layer of flattened membraneless cells, whose confluent walls form a continuous naked protoplasmic stratum, which is raised into numerous small conical elevations arranged somewhat spirally round the tentacle from its base to its apex. In each of these little protoplasmic tubercles are imbedded three or four very minute fusiform thread-cells, the distal ends of which may be often seen projecting beyond the summit of the tubercle.

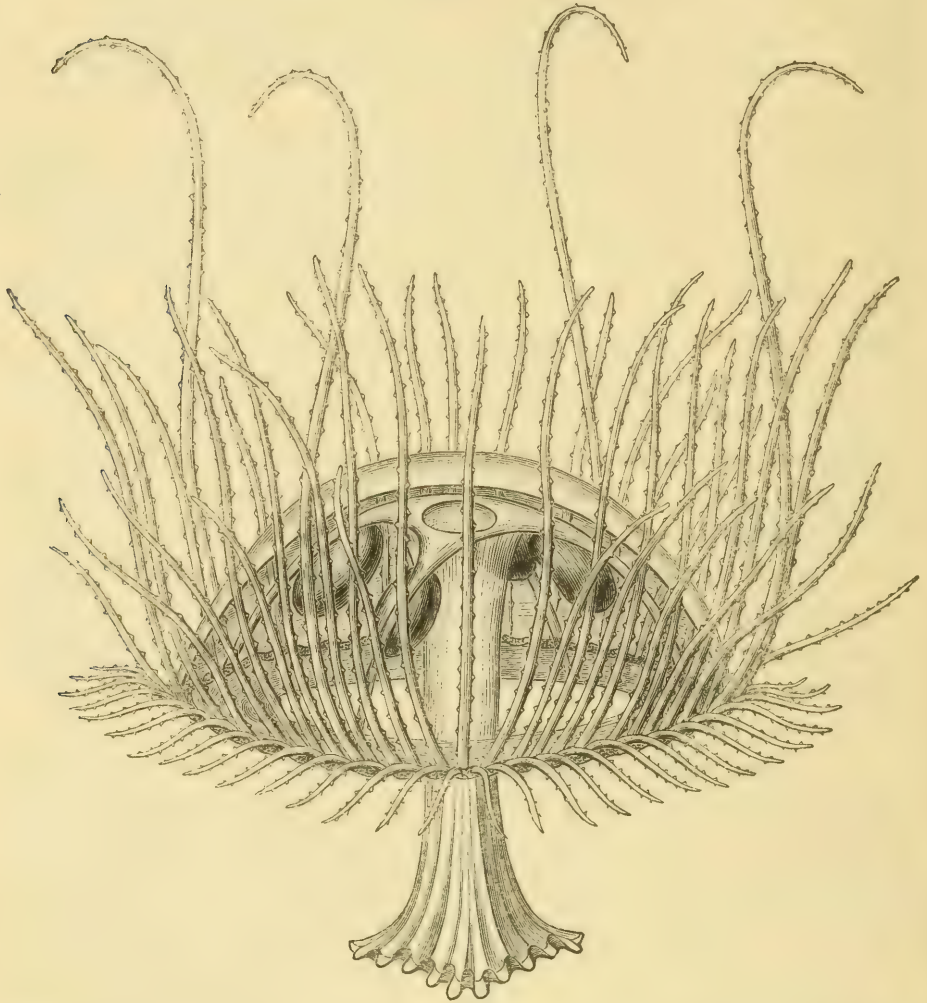
A further affinity of *Limnocodium* may be traced in the direction of *Obelia*, as shown not only by the tentacles being in both destitute of a cavity, but by the fact of their not being free in their entire extent, for in *Obelia* the basal end is plunged, in the form of a root-like continuation, into the substance of the umbrella. Though *Obelia* is in systematic descriptions included among the *Leptomedusæ*, I have elsewhere pointed out indications of affinity between it and the *Narcomedusal* form *Cunina*\*. Its affinity with the *Trachomedusæ* is still closer; but from both groups, as well, indeed, as from the *Leptomedusæ*, a marked point of divergence is found in the suppression of a velum.

Notwithstanding the absence of a cavity, the tentacles of *Limno-*

\* British Association Reports for 1867.

*codium* differ from those of the Trachomedusæ and Narcomedusæ, as well as from *Obelia*, in their great extensibility, the four primary or perradial tentacles admitting of extension in the form of long, greatly attenuated filaments to several times the height of the vertical axis of the umbrella, even when this height is at its maximum, and being again capable of assuming by contraction the form of short thick clubs. Indeed, instead of presenting the comparatively rigid and imperfectly contractile character which prevails among

Fig. 2.



The Medusa with its tentacles extended, and the umbrella in a medium state of contraction. Magnified about 8 diameters.

the Trachomedusæ and the Narcomedusæ, the tentacles of *Limnocodium* possess as great a power of extension and contraction as may be found in those of many Leptomedusæ (*Thaumantidæ* &c.).

The four perradial tentacles contract independently of the others, and seem to form a different system.

The outer surface of the umbrella (exumbrella) is covered with an epithelium composed of flattened hexagonal cells, with very distinct and brilliant nucleus. The subumbrella is also covered with an epithelium formed of broad clear hexagonal cells, in which the nuclei are distinct, but the cell-boundaries far less obvious than in the outer epithelium.

Between these two layers is included the gelatinous substance of the umbrella. This is a clear homogeneous mass with stellate cells scattered through it. The stellate cells consist of small spherical masses of granular protoplasm, destitute of a membrane, usually containing a vacuole, and emitting from two to six long, radiating, very slender, simple or branched processes, which are extensions of their granular substance.

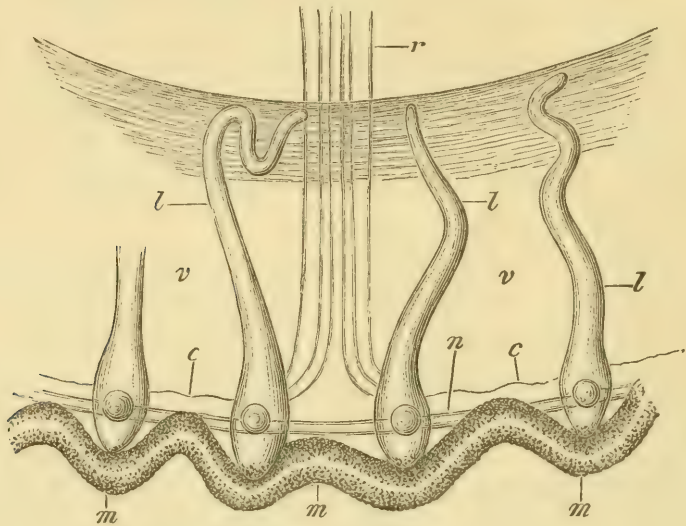
The manubrium is composed of an outer, clear colourless ectoderm and an inner, coloured endoderm. The ectoderm is a continuation of the epithelial covering of the subumbrella, here much thickened, and consisting, like it, of hexagonal nucleated cells. The endoderm, in that part of the manubrium which lies between its dilated base and the mouth, is composed of narrow prismatic cells, whose long axes are perpendicular to the surface, and which contain granules of a yellowish-brown, or, in some specimens, of a greenish colour. The endoderm of the wide basal portion of the manubrium is very remarkable. It consists of a greatly vacuolated granular protoplasm, in which every vacuole contains a distinct granular nucleus. These vacuoles may be regarded as representing the cavities of so many membraneless cells whose boundaries, in consequence of the confluence of their walls, are no longer obvious. This form of tissue, which may be also found in the manubrium of other hydroid Medusæ, passes into that formed by the prismatic cells of the rest of the manubrial endoderm.

The radial canals consist of a thin ciliated endodermal layer continued from the endoderm of the manubrium and surrounded by a thicker ectoderm, which is composed of hexagonal nucleated cells and continued from its ectoderm. Between the ectodermal and endodermal layers is a distinct fibrillated layer, the fibres of which, after accompanying the canal to the point where this enters the marginal canal, here spread out on either side and lose themselves in the subumbrella. Beside these longitudinal fibres, the indications of a fibrillated tissue in the subumbrella are very

indistinct—a condition which contrasts strongly with the highly developed musculature of the subumbrella in the *Trachomedusæ*.

The velum is composed of two layers of nucleated cells having between them an annular layer of muscular fibres ; while between the muscular layer and the lower or abumbral cellular layer are the marginal vesicles, with their caudal extensions running from the attached to the free edge of the membrane.

Fig. 3.



Part of the margin, enlarged.

*m m m*, thickened and sinuated margin ; *v v*, velum ; *l, l, l*, lithocysts ; *r*, radial canal ; *c c*, circular canal ; *n*, nerve-ring.

The reproductive elements are developed between the endodermal layer (spadix) of the sporosac and its ectodermal layer. I believe they take their origin in cells of the endoderm. After a sporosac has become naturally emptied of its contents, it will be found that the space which these had occupied between the endoderm and ectoderm is now traversed by irregular bands of granular protoplasm, which extend from the walls of the spadix internally to the ectoderm externally, being attached by their ends to both these membranes. Some of these bands are simple, others branched. They present here and there fusiform enlargements irregularly distributed along their length.

In many instances a thin layer of clear spherical cells may be seen still closely adhering to the spadix. These I regard as the remains of the spermatogenic tissue ; and their intimate relation with the walls of the spadix, while they are separated by a wide

interval from the outer ectodermal walls of the sporosac, is quite in favour of the endoderm being the seat of their origin.

The marginal nerve-ring can be traced running round the whole margin of the umbrella, and in close relation with the lithocysts\*. A filament is given off from it in each of the four interradi- al spaces, and thence ascends in the subumbrella between the radial canals. Ocelli are not present.

The refringent body which occupies the interior of the litho- cyst consists of an aggregation of highly refringent spherical cor- puscles. I have counted from five to ten such spherules in a single lithocyst. This structure becomes very obvious in speci- mens which have remained for a day or two in a weak magenta solution †.

The generic characters of *Limnocoedium* may be brought together as follows:—

Genus LIMNOCODIUM (*λίμνη* = pond, *κώδων* = bell).

Radial canals 4, each carrying a single reproductive sac ; manu- brium destitute of peduncle, 4-lipped ; marginal tentacles filiform, solid, very numerous, adnate to the outer side of the umbrella for some distance from their insertion into its thickened and sinuous margin ; marginal vesicles each sending into the velum a tubular extension, which terminates blindly at the free edge of this membrane.

\* The terms "otocysts" and "otolites," employed for the marginal bodies of a medusa, are very unsatisfactory. Their significance depends on the assumption that these bodies are organs of hearing. Their being endowed with an auditory function, however, is very far from having been proved. Mr. Busk had long ago given morphological reasons for regarding them as organs destined to receive and transmit impressions of light, while the recent beautiful physiolo- gical experiments of Mr. Romanes give results which point quite in the same direction. Though observation is thus in favour of ascribing to the marginal bodies of the Hydroid Medusæ a photæsthetic function, the very convenient term of "lithocyst" proposed for them by Prof. Huxley, involving, as it does, no idea of disputed function, may be adopted with advantage.

† To this peculiar structure of the otolite my attention was first called by Mr. Busk.